



Land off Worcester Close

Istead Rise, Gravesend

Noise Impact Assessment

17th January 2023

Revision 1



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Revision History

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Executive Summary and Conclusions

This document, a Noise Impact Assessment (NIA), has been written to assess the site suitability in terms of the noise impact from the residual noise environment on the amenity of the future occupants of the proposed development.

In summary, PJA believes that the noise impact on future occupants at the proposed development and the noise impact generated by it on other existing properties can be controlled to an acceptable level providing the recommendations herein are followed.

External Noise Ingress

As per **Section 5.1**, internal ambient noise level (IANL) targets can be met with closed windows, but with a low sound reduction requirement which will be met by all double-glazing systems and likely all trickle vent products. On some elevations and/or on certain days, it is likely that there will be areas in the development that can meet internal targets with open windows. External noise levels are by no means excessive at the site.

Subsequently, as per **Section 5.2**, external amenity noise levels are below or within the recommended 50 – 55 dB $L_{Aeq,16hr}$ upper range for the external amenity spaces to be enjoyed as intended – without requiring further mitigation.

Therefore, noise should not pose a constraint to achieving planning permission for the proposed development, providing the recommendations herein are followed.

Plant Noise Emissions

As covered in **Section 6.0**, noise from the proposed 8 no. external ASHPs have been assessed against the criteria usually conditioned by the Local Planning Authority of a plant noise emission level no greater than the background sound level.

Background noise levels reached a minimum value of 38 dB $L_{A90,5min}$ during the survey. Therefore, plant noise emission levels should not exceed 38 dB when determined 1m outside of neighbouring residential windows.

The predicted specific noise level is 27 dB, resulting in a rating level of 30 dB, which is at least 8 dB below the minimum background sound level (38 dB) recorded during the baseline noise survey, and, therefore, compliant with the limits.

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1.0 Introduction

ParkerJones Acoustics Limited (PJA) has been instructed to undertake a Noise Impact Assessment as part of the planning application for the erection of 8 dwellings within a single flat block with a combination of 1 bed and 2 bed homes, at Land off Worcester Close, Istead Rise, Gravesend (easting: 563646, northing: 170235).

1.1 Scope of Report

This Report, has been written to:

- assess the level of noise ingress from the surrounding area and thus advise on the specification of the building envelope and ventilation system to reduce internal noise levels to acceptable levels for the future occupants;
- assess the risk of plant noise impacting other properties in the area, given that the proposals include an array of ASHPs.

The objective is to ensure that the noise impact is being considered and controlled sufficiently. Therefore, where considered necessary, mitigation measures have been suggested to ensure that identified impacts are minimised.

Whilst every attempt has been made to ensure that this report communicates effectively to a reader who might not have much knowledge of acoustics, some parts are necessarily technical. A glossary of acoustic terminology and concepts is provided in **Appendix A**.

1.2 Regulations and Guidelines

This report takes national planning policies into consideration including the National Planning Policy Framework (NPPF), the Noise Policy Statement for England (NPSE) and the Planning Practice Guidance on Noise (PPG-N) (summarised in **Appendix B**), which outline the purpose and long-term vision of planning policy with respect to noise. More specifically, the assessment has been undertaken with reference to:

- the Professional Practice Guidance on Planning and Noise (ProPG) (2017), which provides guidelines regarding suitable internal ambient noise levels for residential properties;
- BS 8233:2014 *Guidance on sound insulation and noise reduction for buildings*, which “provides guidance on the control of noise in and around buildings” and recommends appropriate criteria and internal noise limits for different situations, including residential developments;
- The World Health Organisation (WHO) ‘*Guidelines for Community Noise*’ (1999) and ‘*Night Noise Guidelines for Europe*’ (2009) documents, which also suggests suitable internal noise levels in dwellings; and
- BS 4142:2014+A1:2019 ‘Methods for rating and assessing industrial and commercial sound’, which assesses the risk of adverse impact of noise pollution from a sound source (or sources) of a commercial or industrial nature (i.e., mechanical/electrical plant).

2.0 Site and Development Description

The site of the proposed development is at Land off Worcester Close, Istead Rise, Gravesend (easting: 563646, northing: 170235). The site location is highlighted in **Figure 2.1** (which also indicates the monitoring position as explained further in **Section 4.0** – denoted as L1).

The site is located on Worcester Close within the Istead Rise village. The existing site forms an irregular triangular shape and consists of a number of trees.

North of the site is Downs Way Medical Practice and a community centre. To the south, the site narrows and adjoins the properties facing onto the corner of Worcester Close. The eastern boundary runs along Worcester Close and the western boundary terminates Bramley Close.

A bridleway runs along the west boundary of the site from The Drove Way to the open space to the north.

The site has an area of circa 0.14 ha. and is currently an undeveloped area with a number of mature trees. Vehicular access to the site is from Worcester Close with additional pedestrian access from Bramley Close.

The proposals involve the erection of 8 dwellings within a single flat block with a combination of 1 bed and 2 bed homes – as shown in **Figure 2.2**.

Figure 2.1 – Aerial view of the site and surrounding area



Figure 2.2- Proposed site plan



Figure 2.3 – Proposed ground floor plan



3.0 Relevant Guidelines

3.1 World Health Organisation (WHO) Environmental Noise Guidelines

The WHO document *Guidelines for Community Noise 1999* has recently been superseded by the *Environmental Noise Guidelines for the European Region*. However, the updated guidance states that 'all WHO guidelines for community noise (CNG) indoor guideline values and any values not covered by the current guidelines (such as industrial noise and shopping areas) should remain valid'.

The 1999 document gives the following description of community noise:

*"Community noise (also called environmental noise, residential noise or domestic noise) is defined as noise emitted from all sources except noise at the industrial workplace. Main sources of community noise include **road, rail and air traffic**, industries, construction and public work, and the neighbourhood. Typical neighbourhood noise comes from premises and installations related to the catering trade (restaurant, cafeterias, discotheques, etc.); from live or recorded music; sport events including motor sports; playgrounds; car parks; and domestic animals such as barking dogs."*

3.1.1 Internal Ambient Noise Levels

For steady continuous noise, the GCN recommends an indoor guideline value for bedrooms of 30 dB $L_{Aeq,8hr}$ and 45 dB L_{AFmax} for a single sound event to prevent sleep disturbance.

3.1.2 Outdoor Amenity Noise Levels

Regarding external noise, the GCN states:

- To protect the majority of people from being seriously annoyed during the daytime, the sound pressure level on balconies, terraces and outdoor living areas should not exceed 55 dB L_{Aeq} for a steady, continuous noise.
- To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound pressure level should not exceed 50 dB L_{Aeq} .

3.2 BS 8233:2014

BS 8233:2014 'Guidance on Sound Insulation and Noise Reduction for Buildings' suggests appropriate criteria and limits for different situations. It is primarily intended to guide the design of new buildings, or refurbished buildings undergoing a change of use.

This includes internal and external noise criteria for residential developments. The limits with BS 8233:2014 are similar to those in the WHO's 'Guidelines for Community Noise' (1999) and 'Night Noise Guidelines for Europe' (2009) documents.

3.2.1 Internal Ambient Noise Levels

Table 4 of BS 8233:2014 provides 'desirable' internal ambient noise level (IANL) limits for dwellings from "steady external noise sources". BS 8233:2014 also notes that "where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved." These targets are summarised in **Table 3.1** below.

Table 3.1 – BS 8233:2014 internal ambient noise level (IANL) upper limits

Activity	Location	Daytime (07:00 – 23:00)		Night-time (23:00 – 07:00)	
		Desirable conditions	Reasonable conditions	Desirable conditions	Reasonable conditions
Resting	Living Room	35 dB L _{Aeq,16hr}	40 dB L _{Aeq,16hr}	-	-
Dining	Dining Room/Area	40 dB L _{Aeq,16hr}	45 dB L _{Aeq,16hr}	-	-
Sleeping (daytime resting)	Bedroom	35 dB L _{Aeq,16hr}	40 dB L _{Aeq,16hr}	30 dB L _{Aeq,8hr}	35 dB L _{Aeq,8hr}

In Annex G.1 of BS 8233:2014 it suggests that "if partially open windows were relied upon for background ventilation, the insulation would be reduced to approximately 15 dB".

Whilst it is desirable to achieve the recommended IANLs with windows open, this is not stipulated as a mandatory requirement within the guidance of BS 8233:2014 which states "if relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level. If applicable, any room should have adequate ventilation (e.g., trickle ventilators should be open) during assessment."

Therefore, a noise limit directly outside of the nearest residential windows could be set based upon the values above plus 15 dB, as per below:

- Desirable internal conditions – Façade noise levels <50 dB L_{Aeq,16hr}
- Reasonable internal conditions – Façade noise levels <55 dB L_{Aeq,16hr}

3.2.2 Outdoor Amenity Noise Levels

BS 8233:2014 indicates that in external areas used for amenity space, it is desirable that external noise levels do not exceed 50 dB L_{Aeq,T} with an upper guideline value of 55 dB L_{Aeq,T} which would be acceptable in noisier environments.

Although in many areas, i.e., next to a strategic transport network, a compromise between elevated noise levels and the convenience of living in these locations may be acceptable. In such a case, the development should be designed to 'achieve the lowest practicable levels' in these external amenity spaces but should not be prohibited.

3.3 The Professional Practice Guidance on Planning and Noise (ProPG)

The ProPG, published in 2017, extends on the guidance and numerical targets within BS 8233:2014 and WHO guidelines, new and extended recommendations where these standards are considered to fall short. Therefore, it is considered to be the most relevant and up to date design standard for assessing the noise impact on new residential developments.

3.3.1 Internal Ambient Noise Levels

The ProPG provides internal ambient noise level targets based upon BS 8233:2014 and WHO guidelines, as shown in the table below. The targets are essentially the same as BS 8233:2014 guidelines but with the addition of an $L_{Amax,F}$ target overnight based on WHO guidelines.

The ProPG indicates that the guidance can be relaxed by up to 5 dB (as does BS 8233:2014) where development is considered necessary or desirable, despite high external noise levels.

Table 3.2 – The ProPG internal ambient noise level (IANL) upper limits

Activity	Location	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Resting	Living Room	35 dB $L_{Aeq,16hr}$	-
Dining	Dining Room/Area	40 dB $L_{Aeq,16hr}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$ 45 dB $L_{Amax,F}$ ¹
¹ a threshold by which 'good acoustic design' is achieved by not exceeding this threshold more than 10 times a night			

Whilst it is desirable to achieve the recommended IANLs with windows open, an assessment can be made with closed windows and open ventilators (i.e., trickle vents) which provide "*whole dwelling ventilation*" (as defined by Building Regulations Approved Document F).

Closed windows do not mean sealed shut/un-openable windows, as occupants would favour the ability to open the windows (especially during the hotter months of the year) even if the resultant internal acoustic conditions aren't as satisfactory.

3.3.2 Outdoor Amenity Noise Levels

The ProPG also provides guidance for outdoor amenity noise levels based upon WHO and BS 8233:2014 guidelines. This applies to gardens, balconies, roof terraces, and patio areas.

If outdoor amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed as intended. Noise levels should ideally not be above the range **50 – 55 dB $L_{Aeq,16hr}$** .

It does, however, accept that this can't be achieved in all situations, in which the development should be designed to achieve the lowest practicable noise levels in these outdoor amenity spaces. The impact can partially be offset by the residents having access to a:

- relatively quiet alternative outdoor amenity space as part of the property, group of residential properties, or a public space in the nearby area; and/or
- a relatively quiet facade (containing openable windows to habitable rooms) or a relatively quiet externally ventilated space (i.e., an enclosed balcony) as part of their dwelling.

3.4 BS 4142:2014

BS 4142:2014 '*Methods for rating and assessing industrial and commercial sound*' is intended to be used to assess the potential adverse impact of sound of an industrial and/or commercial nature, at nearby noise-sensitive receptor (NSR) locations within the context of the existing sound environment.

3.4.1 Definitions

BS 4142:2014 provides the following definitions which are relevant at this pre-construction stage of assessment:

- **Background Sound Level, $L_{A90,T}$:** A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given interval, T, measured using time weighting F and quoted to the nearest whole number of decibels.
- **Rating Level, L_{A,r,T_r} :** Specific sound level plus any adjustment for the characteristic features of the sound.
- **Reference Time Interval, T_r :** Specified interval over which the specific sound level is determined. This is 60-minutes during the day (07:00 – 23:00) and 15-minutes at night (23:00 – 07:00).
- **Specific Sound Level, $L_s = L_{Aeq,T_r}$:** Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r .
- **Specific Sound Source:** Sound source being assessed.

3.4.2 Specific Sound Source

The BS 4142:2014 definition of sound of an industrial and/or commercial nature includes "*sound from fixed installations which comprise mechanical and electrical plant and equipment*".

The scope of BS 4142:2014 is not intended for sound from the passage of vehicles on public roads; people; and 'other sources falling within the scopes of other standards or guidance'.

3.4.3 Specific Sound Level

The specific sound level L_s is the equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r , of 60-minutes during the day (07:00 – 23:00) and 15-minutes at night (23:00 – 07:00).

3.4.4 Rating Level

The rating level $L_{A,r,T}$ is the specific sound level L_s plus any 'penalties' which account for the characteristic features of the sound.

BS 4142:2014 provides the following with respect to the application of penalties to account for *"the subjective prominence of the character of the specific sound at the noise-sensitive locations and the extent to which such acoustically distinguishing characteristics will attract attention"*.

- **Tonality** – For sound ranging from not tonal to predominantly tonal the Joint Nordic Method gives a correction of between 0 dB and +6 dB for tonality. Subjectively, this can be converted to a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible and 6 dB where it is highly perceptible;
- **Impulsivity** – A correction of up to +9 dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be converted to a penalty of 3 dB for impulsivity which is just perceptible at the noise receptor, 6 dB where it is clearly perceptible, and 9 dB where it is highly perceptible;
- **Intermittency** – When the specific sound has identifiable on/off conditions, the specific sound level ought to be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time. If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied; and
- **Other Sound Characteristics** – Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied."

PJA consider the word 'perceptible' to be important, and variable depending on the context of a site. For example at a site with a relatively high background sound level of 50 dB(A), an 'impulsive' sound source with a specific sound level of 30 dB(A) at an NSR is unlikely to be perceptible and should probably not be penalised. However the same source at a site with a lower background level of 30 dB(A) would be perceptible, and therefore a penalty of 3 or 6 dB could be applied to the rating level, with possibly a 9 dB penalty being applied if the specific sound level were to rise from 30 to 40 dB(A). Therefore the context is important in applying rating level penalties.

3.4.5 Background Sound Level

BS 4142:2014 states that *"in using the background sound level in the method for rating and assessing industrial and commercial sound it is important to ensure that values are reliable and suitably represent both the particular circumstances and periods of interest. For this purpose, the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods."*

BS 4142:2014 further states that *"a representative level ought to account for the range of background sound levels and ought not automatically to be assumed to be either minimum or modal value"*.

Hence BS 4142:2014 does not provide a 'black and white' method of obtaining the assessment level for background sound $L_{A90,T}$.

4.0 Baseline Noise Survey

4.1 Methodology

PJA has attended the site to conduct an environmental noise survey between Thursday the 11th and Saturday the 13th of August 2022. The results of the survey have been used to quantify the typical residual noise levels that would be incident on the site and subsequently the proposed development on a day-to-day and night-by-night basis.

A 'long term' measurement position was installed at the location denoted in **Figure 2.1**, positioned within a tree at a height of approximately 3m (to ensure the kit was secure).

The sound level meter was set to log noise levels over continuous 5-minute averaging periods with a 1-second time history rate. Audio files were also recorded on a continuous basis so that any peaks in level could be identified and attributed. The monitoring equipment was left unattended with the exception of setup and collection of the equipment.

The following noise indices were recorded (amongst others):

- $L_{Aeq,T}$: The A-weighted equivalent continuous noise level over the measurement period T. This parameter is typically considered as a good representation of the average ambient sound level;
- $L_{AFmax,T}$: The maximum A-weighted noise level during the measurement period T and the best representation of short high noise levels 'events' – i.e., emergency services sirens;
- $L_{A90,T}$: The A-weighted noise level that is exceeded for 90% of the measurement period T. This parameter is often considered as the 'average minimum level' and is therefore used in determining the representative background noise level – or noise levels from continuous noise sources such as plant; and
- $L_{A10,T}$: The A-weighted noise level that is exceeded for 10% of the measurement period T. This parameter is often considered as the 'average maximum level' and a good representation of traffic noise contributions.

Appendix C contains further information on the methodology of the survey; including the equipment used; photographs from site; and the weather conditions.

4.2 Results

A graph of the measured noise levels across the entire monitoring period at the monitoring position is given in **Figure 4.1**, with a summary provided in **Table 4.1**.

The most consistent and dominant noise source at the site is distant traffic from the A2 and A227. Birdsong was also a significant factor, particularly early in the morning, given the trees currently occupying the site. Intermittent noise was also heard from aircraft on a regular basis, and occasionally from children playing outside of the surrounding houses. Significant on the 12th, was construction noise during the daytime. The following notes attribute the noise sources which caused any notable peaks in the levels in **Figure 4.1**.

- ≈10:30 and 10:40 on the 11th – aircraft (a regular intermittent occurrence over the following days)
- ≈11:40 – 11:55 on the 11th – HGV movements and reversing tone (possibly related to construction works, see below)
- ≈18:05 on the 11th – child screaming
- ≈20:30 – 20:50 on the 11th – birdsong close to the microphone
- ≈23:30 on the 11th – helicopter
- ≈05:20 – 07:30 on the 12th – regular birdsong
- ≈09:00 – 13:30 on the 12th – hammering, drilling, powered machinery – construction works (likely from 22 The Drove Way (application 20220402 for a single storey rear extension approved in May 2022)
- ≈18:30 and 19:30 on the 12th – children shouting
- ≈05:20 – 07:30 on the 13th – regular birdsong (albeit more infrequent than the previous day).

The construction noise on the 12th had a significant effect on the daytime results of the survey on this date, however, this of course would be a temporary noise source and one that would not be occurring once the development is constructed. Hence the period affected by construction noise is discounted from further assessment.

Birdsong is still accounted for in the assessment going forward, albeit a) the microphone was placed in a tree and thus the levels may be inflated with birds much closer to the equipment compared to if the microphone could be safely placed elsewhere on site, and b) the erection of the development would remove some of the trees and thus the level of birdsong may reduce as a consequence.

Traffic along local roads and in/out of the medical practice and the community centre was not significant. The results do not suggest that the site is affected by mechanical plant noise.

Table 4.1 – Summary of measured noise levels

Period	Logarithmic Average $L_{Aeq,T}$ (dB)	95 th Percentile L_{AFmax} (dB)	Median L_{A90} (dB)	Median L_{A10} (dB)
Daytime (07:00 – 23:00) T = 16-hours				
Thursday 11th August; 09:15 - 23:00	51	71	46	51
Friday 12th August; 07:00 - 23:00	62	81	46	52
Saturday 13th August; 07:00 - 11:50	48	71	44	50
Night-time (23:00 – 07:00) T = 8-hours				
Thursday 11th August / Friday 12th August; 23:00 - 07:00	50	65	43	46
Friday 12th August / Saturday 13th August; 23:00 - 07:00	46	63	42	46
Significantly affected by construction noise at a nearby dwelling, a noise source which is temporary and would not be occurring by the time the new development is in place.				

Regarding noise emissions from the development impacting existing noise-sensitive properties, the most relevant parameter in terms of the 'representative background sound level' referenced in BS 4142:2014 is the $L_{A90,5min}$.

Figure 4.3 presents histograms of the $L_{A90,5min}$ values – showing minimum values of 38 dB during the day and night-time periods respectively

Figure 4.1 – Graph of measured noise levels at the monitoring position

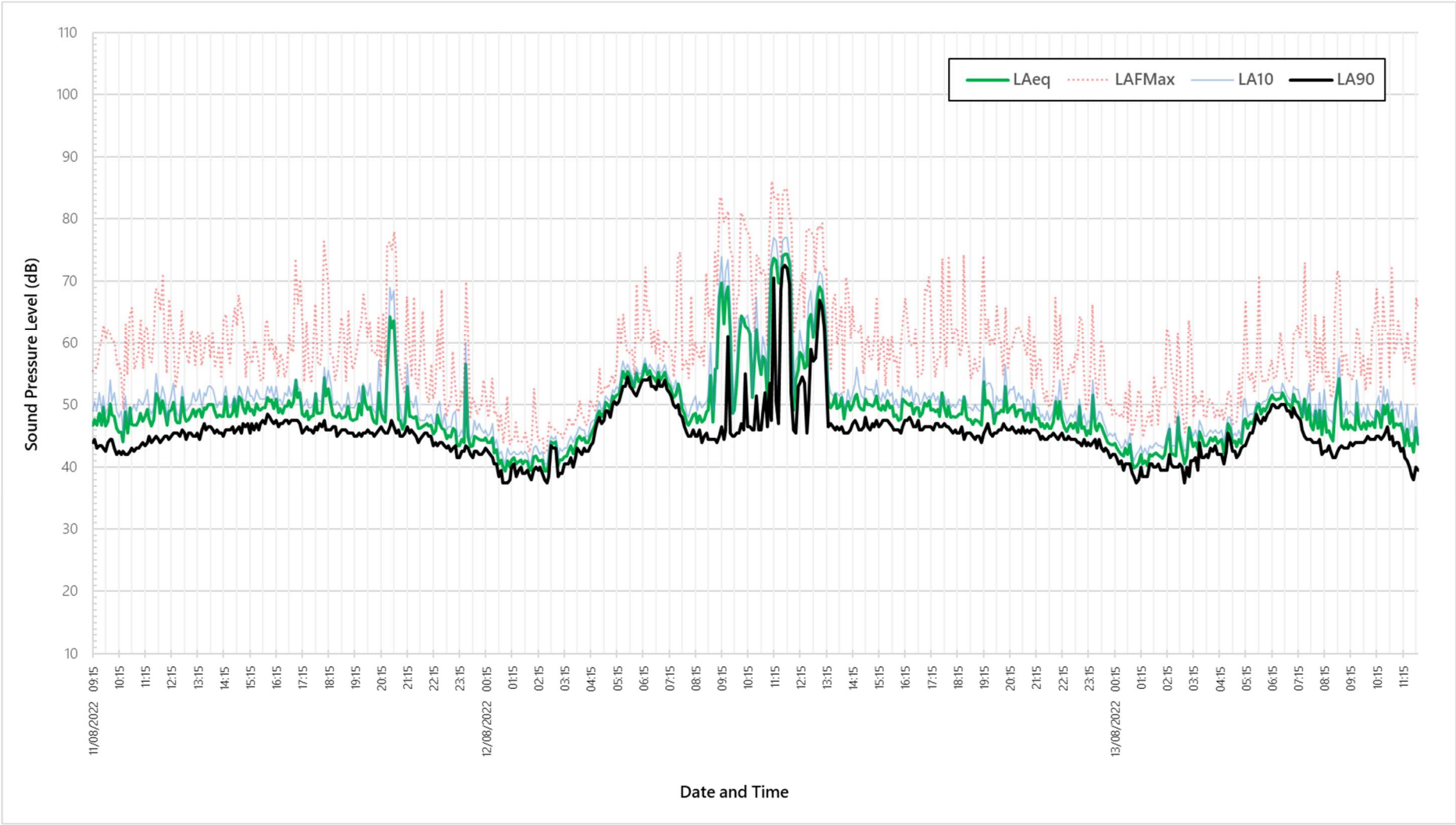
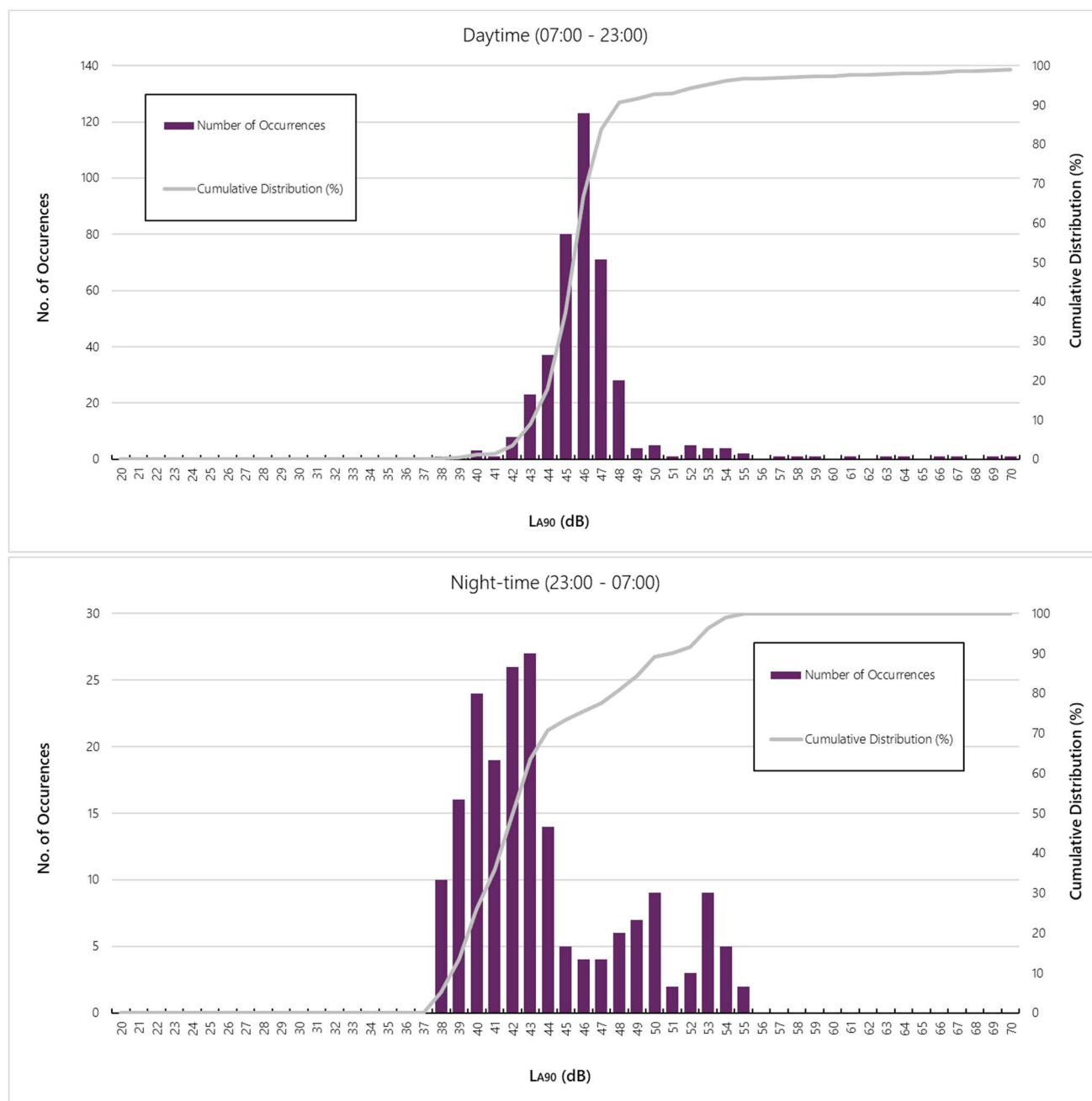


Figure 4.2 – Histograms of measured $L_{A90,5min}$ values



5.0 Impact on the Proposed Development

This section details the impact the existing noise environment would have on the proposed development, including the implications this has on the ventilation strategy and the construction types required within the façade to reduce external noise ingress to an acceptable level for the future occupants.

The following summarises the main steps of action in the assessment method:

- Firstly, the existing ambient noise environment at the site is assessed with the support of an environmental noise survey (**Section 4.0**).
- Noise ingress into living spaces is then assessed against the IANL limits of the ProPG, to determine the sound reduction requirements of the building envelope and determine whether background ventilation can be provided by open windows, trickle ventilators, or mechanical ventilation (to meet IANL limits).
- Noise levels in external amenity areas are assessed in line with the ProPG, BS 8233:2014 and WHO targets.

5.1 External Noise Ingress

5.1.1 Internal Ambient Noise Limits

The criteria for internal ambient noise levels (IANLs) are based upon guidance from BS 8233:2014 and the ProPG. In summary, the proposed development should seek to control IANLs from external noise sources to no greater than:

- Daytime – 35 dB $L_{Aeq,16hr}$; and
- Night-time – 30 dB $L_{Aeq,8hr}$ and 45 dB L_{AFmax} (for no more than 5% of the time).

The criteria apply to bedrooms, the most sensitive room type. The daytime target applies to living rooms (no night-time target is applied to living rooms). A 5 dB relaxation to the daytime target is applied to dining rooms/kitchens.

The criteria are in line with the Lowest Observed Adverse Effect Level (LOAEL) referenced in national planning policy (**Appendix B**).

5.1.2 Building Envelope

The weakest elements of a façade in terms of sound reduction are the windows/glazing. This is particularly true when windows are open (as an open window will typically provide around a 15 dB reduction). Alternative forms of natural background ventilation (such as trickle vents) are also a weak point but can be treated to achieve a much higher level of sound reduction than an open window – so that IANL targets can be met with natural ventilation in areas where the targets would be exceeded when opening the windows.

It is seen that IANLs may not be met across the entire development with open windows, as a reduction in the order of 20 dB is required across the façade (and an open window will typically provide around 15 dB reduction).

It is not unusual for IANL targets to not be met using open windows. It should also not be assumed that windows need to be sealed shut, as many occupants will favour the ability to open their windows at will, particularly during the

hotter months of the year. Once the development is in place, many of the facades may benefit from the screening affected provided by the building itself, which may reduce noise from the distant A-roads to a level where internal levels *can* be met with open windows.

Nonetheless, an alternative form of background ventilation (i.e., trickle vents) should be provided so that IANL targets can be met whilst providing background ventilation to the dwellings with the windows closed (but openable at the occupants' discretion, rather than through necessity). This form of ventilation needs to offer a sufficient enough level of sound reduction to meet IANL targets.

Therefore, **Table 5.1** provides the minimum sound reduction indices for glazing and ventilators (the weakest elements acoustically) to meet IANL targets with windows closed but trickle vents open to provide background ventilation.

The assessment has been based upon a simplified calculation method where only the weakest elements are considered (glazing and ventilators), as the sound reduction provided by the masonry external wall would inherently be considerably higher. The calculation method effectively treats the whole façade as being glazed – this means that a slightly higher and thus more-robust sound reduction index is determined for glazing/trickle ventilators given that a full composite noise ingress calculation in accordance with BS 12354 would include for the high level of external wall performance, and thus require a lesser rating from the glazing to achieve the same overall composite sound reduction index. Hence this approach is seen to be a worst-case approach which results in a better end result for the future occupants.

A non-exhaustive list of example glazing constructions and ventilator products such as trickle vents and air bricks have been provided in **Appendix D**, which are capable of achieving the required $R_w + C_{tr}$ and $D_{n,e,w} + C_{tr}$ indices.

The values in **Table 5.1** are seen to be low performance requirements which will be met by all double-glazing systems and all trickle vent products.

Table 5.1 – Minimum sound reduction requirements of the building envelope

Elevation	External Noise Level @ 1m outside of the facade			Minimum sound reduction indices/construction examples	
	Daytime average (07:00 – 23:00) dB L _{Aeq,16hr}	Night-time average (23:00 – 07:00) dB L _{Aeq,8hr}	Night-time maximum ¹ (23:00 – 07:00) dB L _{AFmax}	Glazing ²	Ventilators ³
All	48 – 51	46 – 50	63 – 65	20 dB R _w + C _{tr} Any double glazing	23 dB D _{n,e,w} + C _{tr} Any trickle vent
Criteria ⁴	<35	<30	<45	-	-
- Estimated top 5% percentile value per night. - A non-exhaustive list of suitable glazing products is given in Appendix D.1. Standard double glazing will usually achieve a minimum sound reduction of 26 dB R_w + C_{tr}. - A non-exhaustive list of suitable ventilator products is given in Appendix D.2. The acoustic performance should meet these values when the vent is open. They may not be required if the development uses mechanical ventilation. Low performance trickle vents will usually achieve a minimum sound reduction of 25 dB D_{n,e,w} + C_{tr}. - Based on the criteria for bedrooms (the most noise-sensitive room type).					

5.2 Outdoor Amenity Noise Levels

WHO Guidelines and the ProPG imply that noise levels in outdoor amenity spaces should ideally not be above the range **50 – 55 dB L_{Aeq,16hr}** for the spaces to be enjoyed as intended.

The survey results suggest (when excluding construction noise) that daytime levels were between 48 and 51 dB L_{Aeq,16hr}, within or below the target upper range.

Therefore, PJA do not believe that any further mitigation would therefore be required and that the external noise levels are at an acceptable level for the enjoyment of the back gardens.

Contextually, the gardens of the development would be in a similar scenario to other residential properties in the surrounding area.

5.3 Summary

In summary, PJA believes that the noise impact on future occupants at the proposed development can be controlled to an acceptable level.

As per **Section 5.1**, internal ambient noise level (IANL) targets can be met with closed windows, but with a low sound reduction requirement which will be met by all double-glazing systems and likely all trickle vent products. On some elevations and/or on certain days, it is likely that there will be areas in the development that can meet internal targets with open windows. External noise levels are by no means excessive at the site.

Subsequently, as per **Section 5.2**, external amenity noise levels are below or within the recommended 50 – 55 dB $L_{Aeq,16hr}$ upper range for the external amenity spaces to be enjoyed as intended – without requiring further mitigation.

Therefore, noise should not pose a constraint to achieving planning permission for the proposed development, providing the recommendations herein are followed.

6.0 Impact on the Surrounding Area

The control of external noise emissions from building services/plant (in this case, the proposed ASHPs to be installed per dwelling) is necessary to ensure that an adverse impact is not created on existing noise-sensitive properties in the surrounding area.

6.1 Criteria

At this stage, there are no planning conditions applied to the development or clear planning guidance from Gravesham Borough Council regarding plant noise emissions.

PJA has reviewed a recently approved planning application (ref: 20210629) which proposals include the “installation of an air source heat pump for each flat” and thus is similar in nature to the proposals assessed herein. The Noise Impact Assessment with the application (which was approved) was based on the following criteria:

“The cumulative rating level of all plant operating simultaneously not to exceed the representative background level (i.e. the threshold for a low impact in BS 4142) at any of the assessment locations, at any time.”

Therefore, the same criteria have been applied here. The assessment locations are considered to be existing properties in the surrounding area, 1m from windows, and 1.2m above ground level in external amenity areas.

6.2 Background Sound Levels

In accordance with BS 4142:2014, the predicted rating level should be assessed against a ‘representative’ background sound level. This is determined through the results of the baseline sound survey (**Section 4.0**).

For a worst-case assessment, the minimum values of the background sound level $L_{A90,5mins}$ of the survey have been set as the representative background sound level - see **Table 6.1**.

Table 6.1 – Derived representative background sound level $L_{A90,T}$ at nearby residential NSRs

Noise-Sensitive Receptor (NSR)	Period	Representative Background Sound Level $L_{A90,T}$ (dB)
All nearby residential properties	Daytime (07:00 to 23:00)	38
	Night-time (23:00 – 07:00)	

6.3 Noise Emission Limits

Given the representative background sound levels and the requirement for the cumulative plant noise rating level to not exceed these background sound levels at any time, the rating noise limits in **Table 6.2** apply.

Table 6.2 – Maximum rating level $L_{A,Tr}$ for all nearby existing properties

Noise-Sensitive Receptor (NSR)	Period	Maximum Rating Noise Level (dB)
1m outside the façade of all nearby existing properties / 1.2m above ground level in external amenity areas	Daytime (07:00 to 23:00)	38
	Night-time (23:00 – 07:00)	

6.4 Proposed Plant

As shown by the drawings in **Figure 2.2 (Section 2.0)**, the proposals include the installation of 8 no. external air source heat pumps at ground floor level.

It is anticipated that the units will be a Vaillant aroTHERM plus air-to-water heat pump (3.5 kW or 5 kW model), with dimensions of 1,100mm wide x 449mm depth x 765mm high.

According to the manufacturer data ^{1,2}, the units have a maximum sound power level of 54 dB(A) and a sound pressure level of 46 dB(A) at 1m in front of the unit.

6.5 Predicted Noise Emissions

The noise predictions within this report have been undertaken using the proprietary software CadnaA® by DataKustik, a 3-D noise mapping package that implements a wide range of national and international standards, guidelines, and calculation algorithms, including those set out in ISO 9613-2:1996. A full explanation of the noise modelling is provided in **Appendix E**, along with images and noise maps/results from the model.

Figures E.2 and E.3 in Appendix E shows the predicted specific noise levels ($L_{Aeq,15min}$) outside of noise-sensitive windows at ground and 1st floor levels respectively.

As per **Section 3.4**, a rating level penalty should be applied when assessing in accordance with BS 4142:2014. It is expected that the noise would likely not have a significant tonal quality, nor be impulsive/intermittent, but *may* be readily distinguishable given the very low background noise levels, hence a 3 dB penalty has been applied.

Table 6.3 summarises the assessment result at the worst affected noise-sensitive receptor window.

1 - <https://www.vaillant.co.uk/for-installers/products/arotherm-plus-71424.html#specification>

2 - <https://www.vaillant.co.uk/downloads/aproducts/renewables-1/arotherm-plus/arotherm-plus-spec-sheet-1892564.pdf>

It is seen that the maximum permissible level is complied with, whereby the rating level at 30 dB is at least 8 dB below the minimum background sound level (38 dB) recorded during the baseline noise survey.

Table 6.3 – Predicted rating noise levels

Location	Period	Specific Noise Level $L_{Aeq,T}$ (dB)	Rating Level Penalties (dB)	Predicted Rating Level $L_{Ar,Tr}$ (dB)	Rating Level Limit $L_{Ar,Tr}$ (dB)	Compliant?
1m outside of the nearest noise-sensitive window	Daytime (07:00 to 23:00)	27	+3	30	≤38	Yes
	Night-time (23:00 – 07:00)					

Appendix A – Acoustic Terminology and Concepts

A.1 – Glossary

Table A.1 – Glossary of acoustic terminology

Term	Description
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio of the root-mean-square pressure of the sound and a reference pressure (2×10^{-5} Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e., 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
C_{tr}	A weighting curve applied to level differences to account for low-frequency noise, typically associated with traffic noise. This is often applied as an addition to $D_{nT,w}$ and R_w ratings used to describe levels of sound insulation.
Frequency	Sound is generally assessed over the frequency range of 63 Hz to 4000 Hz (4 kHz), although humans can potentially hear between 20 Hz and 20 kHz. Frequency is often divided into ('first') octave bands for analysis, with the range above considered within 7-octave bands with centre frequencies at 63 Hz, 125 Hz, 250 Hz, 1 kHz, 2 kHz and 4 kHz. 'Third' octave bands split this further into smaller frequency bands.
$L_{Aeq,T}$	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period. This parameter is typically considered as a good representation of the 'average' overall noise level. It is referred to technically as the A-weighted equivalent continuous sound level and is a dB(A) as defined above.
$L_{A90,T}$	The A-weighted noise level that is exceeded for 90% of the measurement period T. This parameter is often considered as the 'average minimum level'.
$L_{AFmax,T}$	The maximum A-weighted noise level during the measurement period T.
R_w	Weighted sound reduction index. A single number rating of the sound insulation performance of a specific building element. R_w is measured in a laboratory. R_w is commonly used by manufacturers to describe the sound insulation performance of building elements such as plasterboard and concrete.

A.2 – Subjective Changes in Sound Level

Table A.2 – Subjective loudness from an increase or decrease in sound pressure level

Change in sound pressure level	Relative change in sound power energy (multiplier)		Change in apparent subjective loudness (for mid-frequency range)
	Decrease	Increase	
3 dB	1/2	2	'Just perceptible'
5 dB	1/3	3	'Clearly noticeable'
10 dB	1/10	10	'Half or twice as loud'
20 dB	1/100	100	'Much quieter, or louder'

Appendix B – Relevant Planning Policies and Guidelines

B.1 – National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these are expected to be applied. The NPPF provides a framework within which local people and their council can produce their own distinctive local and neighbourhood plans. With explicit reference to noise, the NPPF states that *"Planning policies and decisions should contribute to and enhance the natural and local environment by ... preventing new and existing development from contributing to, being put at unacceptable risk from ... noise pollution"*.

B.2 – Noise Policy Statement for England (NPSE)

The NPPF refers to the Noise Policy Statement for England (NPSE), which applies to most forms of noise including environmental noise. The NPSE sets out the long-term vision of Government policy which is to *"Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development."* It aims that *"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:*

- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life."*

The use of the terms *"significant adverse"* and *"adverse"* are key phrases within the NPSE. The guidance establishes the concept of how the level of adverse effect on health and quality of life can be referenced including:

- **NOEL – No Observed Effect Level** - This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.
- **LOAEL – Lowest Observed Adverse Effect Level** - This is the level above which *adverse* effects on health and quality of life can be detected.
- **SOAEL – Significant Observed Adverse Effect Level** - This is the level above which *significant adverse* effects on health and quality of life occur.

Under the first aim of the NPSE (*"avoid significant adverse impacts on health and quality of life"*), an impact in line with SOAEL should be avoided. Under the second aim (*"mitigate and minimise adverse impacts on health and quality of life"*), where the impact lies somewhere between LOAEL and SOAEL, requiring that all reasonable steps are taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development, but does not mean that such adverse effects cannot occur.

B.3 - Planning Practice Guidance on Noise (PPG-N)

The Planning Practice Guidance on Noise (PPG-N) is part of a suite of web-based guidance which is intended to support the implementation of the policies in the NPPF and the NPSE.

It aids in expanding on the definitions from the NPSE of NOEL, LOAEL and SOAEL, by linking these terms to 'examples of outcomes', i.e., changes in behaviour and/or attitude to noise. The table below summarises the guidance from PPG-N in this regard.

Table B.1 – Noise exposure hierarchy based on the likely average response – adapted from PPG-N

Perception	Examples of outcomes	Increasing effect level	Action
NOEL - No Observed Effect Level ¹			
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
LOAEL - Lowest Observed Adverse Effect Level			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g., turning up the volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
SOAEL - Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g., avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to a change in the acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate the effect of noise leading to psychological stress or physiological effects, e.g., regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g., auditory and non-auditory	Unacceptable Adverse Effect	Prevent
¹ This line is an assumption of the adverse effect level and is not explicitly referenced by PPG-N, though this appears to be a safe assumption.			

Appendix C – Noise Survey Details

C.1 – Survey Equipment

The monitoring equipment used for the baseline noise survey is detailed in the table below. The sound level meter was calibrated before and after the survey, with no significant drifts of greater than 0.5 dB observed. The sound level meter has been calibrated to a traceable standard within the 24 months preceding the survey, and the calibrators have been calibrated to a traceable standard within the 12 months preceding the survey. The equipment complies with the standards of as BS EN 60942:2003 Class 1 device.

Table C.1 – Equipment used for the noise survey

Name	Serial Number	Last Calibrated	Calibration Due
Casella CEL 633C Class 1 Sound Level Meter	2145374	18/02/2022	18/02/2024
B&K 4189 Class 1 Microphone	2529821	18/02/2022	18/02/2024
Casella CEL 120-1 Acoustic Calibrator	113251	18/02/2022	18/02/2023

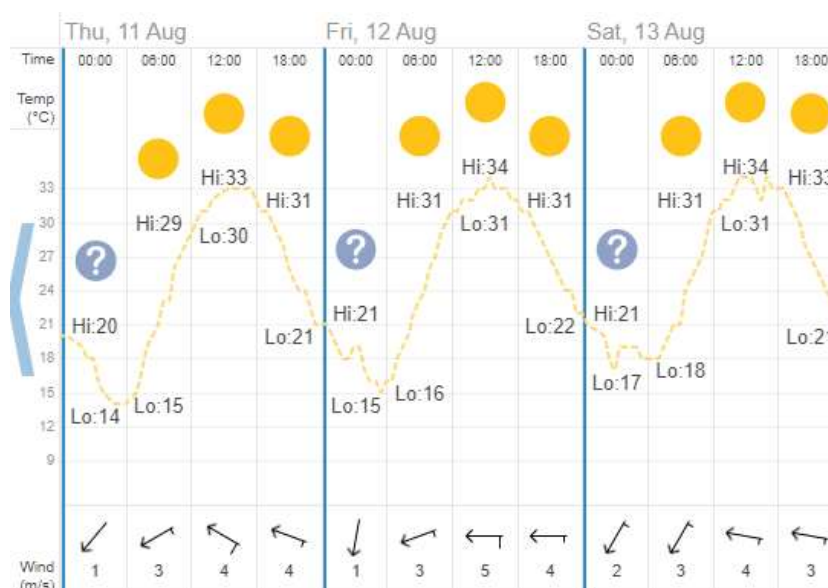
C.2 – Meteorological Conditions

During the survey, weather conditions were dry, hot, and calm. The microphone was fitted with a weather protection kit/windshield). These weather conditions are suitable for the measurement of environmental noise in accordance with BS 7445 'Description and Measurement of Environmental Noise'.

The weather data below has been sourced from

<https://www.timeanddate.com/weather/@12265368/historic?month=8&year=2022>.

Figure C.1 – Meteorological conditions during the survey



C.3 – Photographs

Figure C.2 – Photographs from the noise survey



Appendix D – Example Façade Constructions

D.1 - Glazing

Table D.1 – Example glazing constructions and associated sound reduction indices

Single / Double / Triple	Configuration	Manufacturer	R _w + C _{tr} (dB)
Double	4 (12) 6	Saint Gobain	29
Double	5 (12) 4	Saint Gobain	29
Double	4 (16) 8	Saint Gobain	30
Double	4 (12) 6.8P	Pilkington	30
Double	4 (10) 10	Saint Gobain	31
Double	6 (25) 4	Saint Gobain	31
Double	8 (18) 6	Saint Gobain	32
Double	8.8L (12) 8.8P	Pilkington	32
Double	4 (6) 10	Saint Gobain	33
Triple	4 (12) 4 (12) 8.4S	Saint Gobain	33
Double	4 (16) 8.8P	Pilkington	33
Double	10 (15) 6	Saint Gobain	34
Double	8 (6) 8.8S	Saint Gobain	34
Double	6 (16) 8.8P	Pilkington	34
Double	10 (6) 8.8S	Saint Gobain	35
Double	6 (24) 10	Saint Gobain	35
Double	6 (12) 9.5A	Saint Gobain	35
Triple	8 (12) 4 (12) 8.8P	Pilkington	35
Double	8 (12) 8.8A	Saint Gobain	36
Double	10 (12) 8.8A	Saint Gobain	37
Double	8.4A (16) 10.4A	Saint Gobain	38
Double	8.8P (16) 12.8P	Pilkington	39
Double	10 (16) 12.4A	Saint Gobain	40
Double	12.8A (15) 12.8A	Saint Gobain	41
Double	9.1P (20) 13.1P	Pilkington	42
Double	9.1P (20) 17.1P	Pilkington	43
Double	16.8A (15) 16.8A	Saint Gobain	44
Double	9.1P (20Arg) 17.1P	Pilkington	44
NOTATION A = Stadip Silence S = Stadip P = Optiphon L = Optilam Arg = Argon Cavity			
Further data at https://techhub.uk.saint-gobain-building-glass.com/acousticcalculator			

D.2 - Ventilators

For each additional ventilator, the required $D_{n,e,w} + C_{tr}$ should be increased by $10\log(n)$, where 'n' is the number of ventilators. The $D_{n,e,w} + C_{tr}$ must be assessed in the **open position**.

Table D.2 – Example ventilator products and associated sound reduction indices

Product	$D_{n,e,w} + C_{tr}$ (dB)
Duco DucoTop 60 SR (over window frame) – Corto STD	25
Duco DucoTop 60 SR (over window frame) – Corto AK	26
Duco DucoTop 60 SR (over window frame) – Grando STD	27
Duco DucoTop 60 SR (over window frame) – Corto AK+	28
Duco DucoTop 60 SR (over window frame) – Alto AK	30
Duco DucoTop 60 SR (over window frame) – Basso AK+	30
Titon Invent	30
Duco DucoTop 60 SR (over window frame) – Grando AK	31
Titon Hit & Miss HM5050	31
Duco DucoTop 60 SR (over window frame) – Medio AK+	32
Duco DucoStrip Slimline	32
Duco GlasMax – Air slot 20mm	32
Ryttons R2700 Window trickle ventilator (412mm wide)	33
Titon SF 3300 EA Vent	33
Greenwood Slotvent 3000S	33
Duco GlasMax – Air slot 10mm	34
Greenwood 2000D	35
Duco DucoTop 60 SR (over window frame) – Largo AK+	35
Duco DucoMax Corto 15	36
Duco DucoTop 60 SR (over window frame) – Grando AK+	37
Duco DucoMax Medio 25	37
Duco DucoMax Alto 25	38
Titon SF Xtra Sound Attenuator	39
Willan Fresh 100dB	40
Greenwood Airvac Acoustic Air Brick AAB-4000	40
Duco DucoMax Corto 10	41
Duco DucoMax Medio 15	42
Greenwood EHA574	42
Duco DucoMax Alto 15	43
Duco DucoMax Alto 10	45

Appendix E – Plant Noise Calculations

The noise predictions within this report have been undertaken using the proprietary software CadnaA® by DataKustik, a 3-D noise mapping package that implements a wide range of national and international standards, guidelines, and calculation algorithms, including those set out in ISO 9613-2:1996.

All of the objects within the model (buildings, roads, barriers, foliage, etc) have been imported from OpenStreetMap. The heights of the buildings and roads have been based upon Google Earth Pro, using the 3D view to be able to measure the elevation heights at the tops of objects, and then inserting this manually into the model. Where OpenStreetMap contains little or inaccurate information, the objects have been drawn manually. The scaled site plan, floor plan, and elevation for the proposed development have been accounted for in the model.

The noise model has been used to predict the resulting L_{Aeq} noise emissions from the proposed plant.

The noise model has assumed:

- downwind propagation, i.e., a wind direction that assists the propagation of sound from source to receptor, as a worst-case;
- a maximum reflection factor of three where buildings and barriers are assumed to have a 'smooth' reflective façade, as a worst-case;
- a ground absorption factor of 0 to represent hard, reflective ground as a worst-case.
- receptor heights on the façade at ground floor (1.5m) and 1st floor (4.3m) window heights, placed at 1m outside of elevations which contain windows.
- a receptor is also placed 1m in front of the unit at a height of 1.5m above ground (to replicate the measurement position from the manufacturers testing).
- atmospheric sound absorption based upon a temperature of 10°C and a humidity level of 70%, as per Table 2 of ISO 9613-2:1996

The images on the following pages contain the results of the mapping.

Figure E.1 – Views of the model setup

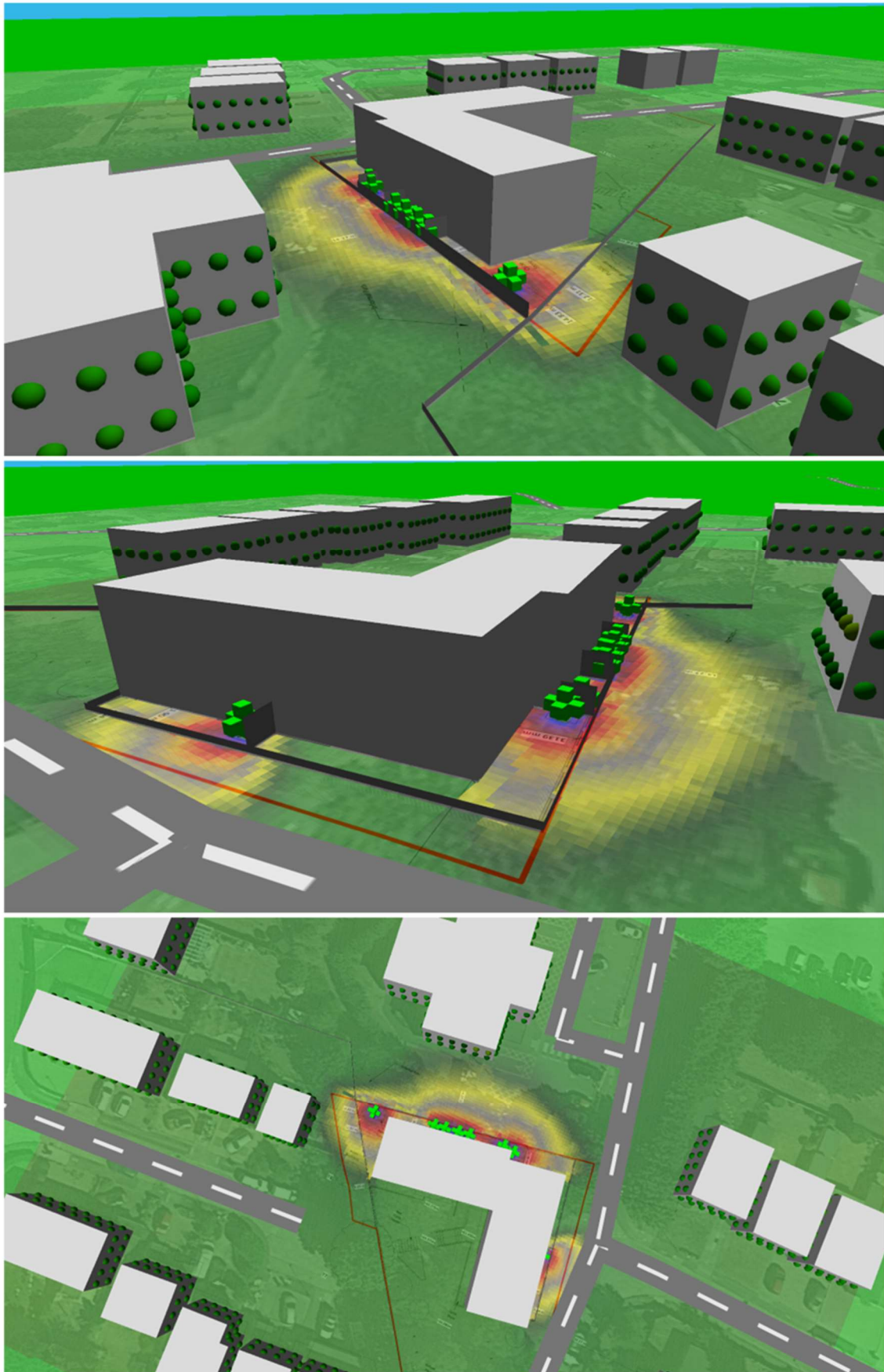


Figure E.2 – Predicted plant noise emissions (dB L_{Aeq}) – ground floor (1.5m)



The map displays a topographic view of a park area. A path, labeled 'T8', is shown with a series of green dots indicating its route. The path starts near a building and extends towards the top right. The building is a large, white, rectangular structure with a red roof. The map includes a coordinate grid with values ranging from 563605 to 563660 on the x-axis and 170200 to 170290 on the y-axis. A legend in the bottom right corner provides elevation ranges in meters, color-coded from light green to dark blue. The map also shows various features such as 'Public Bridleway', 'Cycle Paths', and 'Cycle Stairs'.

Elevation Range (m)	Color
... < 23.0	Light Green
23.0 <= ... < 26.0	Dark Green
26.0 <= ... < 29.0	Yellow
29.0 <= ... < 32.0	Light Green
32.0 <= ... < 35.0	Grey
35.0 <= ... < 38.0	Orange
38.0 <= ... < 41.0	Red
41.0 <= ... < 44.0	Purple
44.0 <= ... < 47.0	Dark Blue
47.0 <= ... < 50.0	Blue
50.0 <= ... < 53.0	Dark Blue
53.0 <= ...	Dark Blue



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